IN THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Withdrawn) A variable optical-property element, wherein a high degree of brightness is obtained and a polarizing plate is out of use.

2. (Withdrawn) A variable optical-property element according to claim 1, wherein a variable refractive-index substance causes a refractive index to have a spatially uneven distribution and optical properties of said variable optical-property element are changed by varying a distribution of said refractive index.

3. (Withdrawn) A variable optical-property element according to claim 2, wherein one of a macromolecular dispersed liquid crystal and a macromolecular stabilized liquid crystal is used as said variable refractive-index substance.

4. (Withdrawn) A variable optical-property element according to claim 2, wherein a substance in which a refractive index is periodically changed in one direction is used as said variable refractive-index substance.

5. (Withdrawn) A variable optical-property element according to claim 2, wherein a liquid crystal is used as said variable refractive-index substance and an orientation of molecules of said liquid crystal is controlled by changing a frequency of an electric field or a magnetic field.

6. (Withdrawn) A variable optical-property element according to claim 1, wherein a macromolecular stabilized liquid crystal is used.

7. (Withdrawn) A variable optical-property element using a macromolecular stabilized liquid crystal, satisfying at least one of the following conditions:

$D < \lambda / 5$

$D < 2\lambda$

$0.5 < ff' < 0.999$

$0.1 < ff' < 0.5$

where D is an average diameter of molecules of said macromolecular stabilized liquid crystal, λ is a wavelength of incident light, and ff' is a ratio in volume between said liquid crystal and said molecules.

8. (Withdrawn) A variable optical-property element using a macromolecular stabilized liquid crystal as a variable refractive-index substance, wherein a frequency of an electric field or a magnetic field is changed and thereby an orientation of molecules of said macromolecular stabilized liquid crystal is controlled.

9. (Withdrawn) A variable optical-property element using a liquid crystal in which an anisotropy of refractive index is negative, as a variable refractive-index substance, wherein a frequency of an electric field or a magnetic field is changed and thereby an orientation of molecules of said liquid crystal is controlled.

10. (Withdrawn) A variable optical-property element using a liquid crystal in which a refractive index is periodically changed in one direction, as a variable refractive-index substance, wherein a frequency of an electric field or a magnetic field is changed and thereby an orientation of molecules of said liquid crystal.

11. (Withdrawn) A variable optical-property element wherein an orientation of molecules of a variable refractive-index substance in a plane nearly perpendicular to an optical axis is substantially uniform in said plane.

12. (Withdrawn) A variable optical-property element according to claim 11, wherein a liquid crystal is used as said variable refractive-index substance and an orientation of molecules of said liquid crystal is controlled by changing a frequency of an electric field or a magnetic field.

13. (Withdrawn) A variable optical-property element according to claim 11, wherein said variable refractive-index substance whose molecules are periodically oriented satisfies the following condition:

$$0.5 \text{ nm} < S < \lambda$$

where S is a period of an orientation of said molecules and λ is a wavelength of light.

14. (Withdrawn) A variable optical-property element using photoresist exposure and etching or lithographic technology in order to make a member for controlling a direction of an arrangement or an orientation of molecules of a variable refractive-index substance.

15. (Withdrawn) A variable optical-property element having a variable refractive-index substance provided with a structure such that an electric field or a magnetic field is applied in a direction nearly perpendicular to an optical axis.

16. (Withdrawn) A variable optical-property element having a variable refractive-index substance, wherein a structure such that an electric field or a magnetic field is applied in a direction nearly parallel to an optical axis and a structure such that said electric field or said magnetic field is applied in a direction nearly perpendicular to said optical axis are provided.

17. (Withdrawn) A variable optical-property element wherein a temperature of a variable refractive-index substance is changed and thereby optical properties of said variable optical-property element are varied.

18. (Withdrawn) A variable optical-property element wherein a variable refractive-index substance in which a refractive index is periodically changed in one direction or a variable refractive-index substance with a pseudo-period is used.

19. (Withdrawn) A variable optical-property element having a variable refractive-index substance, wherein a substance in which a refractive index is changed at a period P in one direction is used as said variable refractive-index substance and said period P satisfies at least one of the following conditions:

$P \geq \lambda$

$P \geq 2\lambda$

where λ is a wavelength of light

20. (Withdrawn) A variable optical-property element having a variable refractive-index substance, wherein a substance in which a refractive index is changed at a period P in one direction is used as said variable refractive-index substance, satisfying at least one of the following conditions:

$P \geq \lambda$

$|\Gamma / 2\Phi| < 0.11$

$|\Gamma / 2\Phi| < 1$

$|\Gamma / 2\Phi| < \pi / 6$

$|\Gamma / 2\Phi| < \pi$

$P < 20\pi \cdot \lambda \approx 62.8\lambda$

$P < 20\lambda$

$\lambda \leq P < 20\lambda$

$\lambda \leq P$ and $|\Gamma / 2\Phi| < \pi$

$2\lambda \leq P < 20\lambda$

$2\lambda \leq P$ and $|\Gamma / 2\Phi| < \pi$

$(2 / 3)\lambda \leq P < 20\lambda$

$(2 / 3)\lambda \leq P$ and $|\Gamma / 2\Phi| < \pi$

where λ is a wavelength of light, and Γ and Φ are defined as

$\Gamma = 2\pi(ne - n_0)d / \lambda$

$\Phi = 2\pi d / P$

where d is a thickness of said variable refractive-index substance, ne is a refractive index of said variable refractive-index relative to extraordinary light, and n_0 is a refractive index of said variable refractive-index relative to ordinary light.

21. (Withdrawn) A variable optical-property element according to claim 20, wherein a liquid crystal whose molecules are helically oriented at said period P is used as said variable refractive-index substance.

22. (Withdrawn) A variable optical-property element according to claim 20, wherein a frequency of an electric field or a magnetic field is changed and thereby an orientation of molecules or said variable refractive-index substance is controlled.

23. (Withdrawn) A variable optical-property element according to claim 21, wherein said liquid crystal has a positive anisotropy of refractive index.

24. (Withdrawn) A variable optical-property element according to claim 23, wherein a frequency of an electric field or a magnetic field is changed and thereby an orientation of molecules of said liquid crystal is controlled.

25. (Withdrawn) A variable optical-property element shaped into a concave form, using a liquid crystal in which an anisotropy of refractive index is negative.

26. (Withdrawn) A variable optical-property element according to claim 19, wherein said variable refractive-index substance is a liquid crystal that has a property of totally reflecting light with a particular wavelength, and said particular wavelength is outside a range of wavelengths of light used for said variable optical-property element.

27. (Withdrawn) An optical system comprising:

a front lens unit including a stop and a variable optical-property element placed in the proximity of said stop, and

a rear lens unit including at least one concave surface and one convex surface, placed behind said front lens unit.

28. (Withdrawn) An optical system comprising:

a front lens unit including a stop and a variable optical-property element shaped into a concave form, placed in the proximity of said stop, and

a rear lens unit including at least one concave surface and one convex surface, placed behind said front lens unit.

29. (Withdrawn) An optical system according to claim 27, wherein at least one aspherical surface is provided.

30. (Withdrawn) An optical system according to claim 27, wherein an angle of a chief ray of light incident on an imaging surface is within a range of 90±20° with respect to said imaging surface.

31. (Withdrawn) An optical system including at least one variable focal-length lens with negative power and at least one variable focal-length lens with positive power.

32. (Withdrawn) An optical apparatus having said variable optical-property element or said optical system of the preceding claims.

33. (Withdrawn) An optical apparatus comprising:

an optical system for forming an object image, said optical system comprising a variable optical-property element;

an image sensor constructed and arranged to image said object image; and

an image processing device constructed and arranged to perform an image processing by using an image data obtained by said image sensor, said image processing device comprising a process for carrying out a process for modifying said image data in response to a change of light deflective action of said variable optical-property element.

34. (Withdrawn) A variable optical-property element according to claim 20, wherein said variable refractive-index substance is a liquid crystal that has a property of totally reflecting light with a particular wavelength, and said particular wavelength is outside a range of wavelengths of light used for said variable optical-property element.

35. (Withdrawn) An optical system according to claim 28, wherein at least one aspherical surface is provided.

36. (Withdrawn) A variable optical-property element, wherein a variable refractive-index substance having a structure of a negative anisotropy of refractive index and a period P is used, satisfying at least one of the following conditions:

$P < \lambda$

$| \Gamma / 2\Phi | << 1$

$| \Gamma / 2\Phi | < 1$

$| \Gamma / 2\Phi | < \pi / 6$

$| \Gamma / 2\Phi | < \pi$

$2 \mu < d < 300 \mu$

$P < 60\lambda$

$P < 20\lambda$

$P < 20\pi \cdot \lambda \approx 62.8\lambda$

$P < 20\lambda$

where λ is a wavelength of light, and Γ and Φ are defined as

$\Gamma = 2\pi(ne - no)d / \lambda$

$\Phi = 2\pi d / P$

where d is a thickness of said variable refractive-index substance, ne is a refractive index of said variable refractive-index relative to extraordinary light, and no is a refractive index of said variable refractive-index relative to ordinary light.

37. – 39. (Cancelled).

40. (Currently Amended) An optical apparatus comprising[[:]] an optical system that forms a two-dimensional image,

the optical system comprising a variable optical-property mirror ~~having a reflecting surface, a length thereof along a first direction being longer than a length thereof along a second direction~~,

wherein the variable optical-property mirror is arranged to be decentered from a light-incident-side optical axis, and

wherein the variable optical-property mirror ~~itself is physically changeable, and~~

~~wherein a two-dimensional image is formed by the reflecting surface of the variable optical property mirror~~ has a reflecting surface that is deformable.

41. (Currently Amended) An optical ~~device~~ system comprising:

a variable optical-property element; and

~~an optical element having~~ a plurality of rotationally asymmetric curved surfaces ~~and having a light-deflecting function~~,

wherein the variable optical-property element ~~has an optical surface, a light-deflecting function of the optical surface itself being changeable~~ and the plurality of rotationally asymmetric curved surfaces are arranged along a single traveling path of rays, and

wherein the variable optical-property element ~~contributes to forming a two-dimensional image~~ is arranged to be decentered from an optical axis of the optical system.

42. (Currently Amended) An optical ~~device~~ system according to claim ~~41~~ 98, further comprising an image sensor.

43. - 47. (Cancelled).

48. (Currently Amended) An optical ~~device~~ system according to ~~41~~ 42, wherein each of ~~said~~ the variable optical-property ~~mirror~~ element and ~~an~~ the image sensor is disposed on a surface of ~~said~~ the optical element provided with ~~a~~ the plurality of rotationally asymmetric curved surfaces.

49. (Currently Amended) An optical system comprising:

a variable optical-property mirror; and

an optical element having a light-deflecting function and disposed ~~at the front side~~ before or ~~the back side of~~ after the variable optical-property mirror in a single traveling path of rays,

wherein a shape of a reflecting surface of the variable optical-property mirror ~~itself~~ is ~~physically~~ changeable,

wherein the variable optical-property mirror is arranged to be decentered from a light-incident-side optical axis, and

wherein the optical element has a rotationally asymmetric surface having a shape that defines only one plane of symmetry or no plane of symmetry.

50. (Withdrawn) An observation apparatus comprising:
an optical element having a rotationally asymmetric surface; and
a variable optical-property mirror.

51. (Withdrawn) An observation apparatus according to claim 50, wherein said variable optical-property mirror is placed in a vicinity of said rotationally asymmetric surface.

52. (Withdrawn) An observation apparatus according to claim 50, wherein said variable optical-property mirror is disposed in a vicinity of a prism having said rotationally asymmetric surface.

53. (Withdrawn) An observation apparatus according to claim 50, further comprising a display element.

54. (Withdrawn) An optical apparatus comprising:
an image sensor and an optical element;
a supporting member for holding said image sensor and said optical element; and
another optical element disposed in a vicinity of said supporting member.

55. (Withdrawn) An optical apparatus according to claim 54, wherein said another optical element disposed in the vicinity of said supporting member has a reflecting surface.

56. (Withdrawn) An optical apparatus according to claim 54, wherein said optical apparatus comprises a variable optical-property element.

57. (Withdrawn) An optical apparatus, comprising:
an optical system having a plurality of reflecting-type variable optical-property elements and having a zooming function or a focusing function, and said variable optical-property elements being arranged on a same optical path.

58. (Withdrawn) An optical apparatus according to claim 57, further comprising an optical element.

59. (Withdrawn) An optical apparatus according to claim 57, further comprising a lens.

60. (Withdrawn) An optical apparatus according to claim 57, further comprising a display element.

61. (Withdrawn) An optical apparatus according to claim 57, further comprising a display element and an image sensor.

62. (Withdrawn) An optical apparatus according to claim 57, further comprising at least one of an infrared cutoff filter and a low-pass filter.

63. (Withdrawn) An optical apparatus according to claim 57, further comprising a stop.

64. (Withdrawn) An optical apparatus according to claim 57, further comprising a processor.

65. (Withdrawn) An optical apparatus according to claim 57, further comprising a recorder.

66. (Withdrawn) An optical apparatus according to claim 57, wherein said reflecting-type variable optical-property element is constructed with a variable shape mirror.

67. (Withdrawn) An observation apparatus. comprising:

a variable focal-length optical system comprising a reflecting-type variable optical-property element; and

a display element.

68. (Withdrawn) A display apparatus, comprising:

a variable focal-length optical system comprising a reflecting-type variable optical-property element; and

a display element.

69. (Withdrawn) An optical apparatus, comprising:

a variable focal-length optical system comprising a reflecting-type variable optical-property element;

an image sensor disposed at the position of an image formed by said variable focal-length optical system; and

a display element constructed and arranged to display an image based on an output from said image sensor.

70. (Withdrawn) An apparatus according to claim 69, further comprising an optical element.

71. (Withdrawn) An apparatus according to claim 69, further comprising a lens.

72. (Withdrawn) An imaging apparatus, comprising:

a variable focal-length optical system comprising an infrared cutoff filter or a low-pass filter and a reflecting-type variable optical-property element;

an image sensor disposed at the position of an image formed by said optical system; and

a display element constructed and arranged to display an image based on an output from said image sensor.

73. (Withdrawn) An apparatus according to claim 69, wherein a stop is disposed in said variable focal-length optical system.

74. (Withdrawn) An apparatus according to claim 69, further comprising a processor.

75. (Withdrawn) An apparatus according to claim 69, further comprising a recorder.

76. (Withdrawn) An apparatus according to claim 69, wherein said reflecting-type variable optical-property element is constructed with a variable shape mirror.

77. (Currently Amended) An optical apparatus[[,]] comprising[[:]] an optical system that forms a two-dimensional image,

the optical system comprising:

an optical element; and

a plurality of variable optical-property elements each having a reflecting surface that is deformable,

wherein the optical element and the plurality of variable optical-property elements are arranged along a single traveling path of rays, and

wherein each of the variable optical-property elements is arranged to be decentered from a light-incident-side optical axis~~,~~

~~wherein each of the variable optical-property elements has an optical surface, a shape of the optical surface being changeable, and~~

~~wherein the variable optical-property elements contribute to forming a two-dimensional image~~.

78. (Previously Presented) An optical apparatus according to claim 77, further comprising an image sensor.

79. (Withdrawn) An optical apparatus comprising:

an optical element molded from a material which is plastic or glass;

an image sensor;

a display element; and

a reflecting-type variable optical-property element.

80. (Withdrawn) An optical apparatus comprising:

an optical element molded from a material which is plastic or glass;

an image sensor;

a display element; and

a reflecting-type variable optical-property element fabricated by lithography.

81. (Withdrawn) An imaging device, comprising:

an optical element having a rotationally asymmetric surface;

a variable mirror; and

an image sensor,

wherein said variable mirror and said image sensor are placed on a same substrate, and said variable mirror and said optical element constitute a whole or a part of an optical system.

82. (Withdrawn) An optical apparatus according to claim 41, wherein each of said variable optical-property mirror and an image sensor is disposed to oppose one of said plurality of rotationally asymmetric surfaces of said optical element.

83. (Withdrawn) An optical apparatus or an assembly of an optical apparatus according to claim 54, comprising a reflecting-type variable optical-property element.

84. (Currently Amended) An optical device ~~constantly~~ comprising:

a variable optical-property element; and

a rotationally asymmetric reflecting surface,

wherein the ~~variable optical-property element has an optical surface, a light-deflecting function of the optical surface itself being changeable;~~ rotationally asymmetric reflecting surface defines only one plane of symmetry or no plane of symmetry, and

wherein the variable optical-property element and the rotationally asymmetric reflecting surface are arranged to be decentered from one another.

85. (Cancelled).

86. (Previously Presented) An optical device according to claim 84, wherein the variable optical-property element is a reflection-type element.

87. (Cancelled).

88. (Currently Amended) An optical ~~apparatus constantly comprising:~~

~~a variable optical-property element; and~~

~~an optical element having a rotationally asymmetric reflecting surface,~~ system according to claim 41, wherein the rotationally asymmetric curved surfaces of the optical element are reflecting ~~surface is~~ surfaces and are arranged to be decentered from ~~a light-incident side~~ the optical axis~~,~~

~~wherein the variable optical-property element has an optical surface, a light-deflecting function of the optical surface itself being changeable, and~~

~~wherein the rotationally asymmetric reflecting surface includes no mirror array~~ of the optical system.

89. – 90. (Cancelled).

91. (Currently Amended) An optical apparatus comprising:

an optical element; and

a plurality of variable optical-property elements,

wherein each of the variable optical-property elements ~~are~~ is arranged to be decentered from a light-incident-side optical axis,

wherein each of the variable optical-property elements has an optical surface, a shape of the optical surface being changeable, and

wherein ~~each of the variable optical-property elements includes no optical-element array~~ the optical element and the plurality of variable optical-property elements are arranged along a single traveling path of rays.

92. (New) An optical apparatus according to claim 40, further comprising an image sensor.

93. (New) An optical apparatus according to claim 40,

wherein the optical system forms an image surface on an exit side thereof, and

wherein the optical system further comprises an optical element arranged between the image surface and the reflecting surface of the variable optical-property mirror.

94. (New) An optical apparatus according to claim 40, wherein the optical system further comprises an optical element having a rotationally asymmetric optical surface.

95. (New) An optical apparatus according to claim 40,

wherein the optical system further comprises a rotationally asymmetric reflecting surface, and

wherein the rotationally asymmetric reflecting surface is arranged to be tilted in reference to an optical axis of the optical system.

96. (New) An optical apparatus according to claim 95, wherein the rotationally asymmetric reflecting surface defines only one plane of symmetry or no plane of symmetry.

97. (New) An optical apparatus according to claim 40, wherein the optical system further comprises an optical element that has a plurality of rotationally asymmetric optical surfaces.

98. (New) An optical system according to claim 41, wherein the plurality of rotationally asymmetric curved surfaces are provided on a single optical element.

99. (New) A variable optical-property element comprising:

a reflecting surface formed as a curved surface; and

a layer made of a transmissive medium with a variable refractive index, the layer being constructed integrally with the reflecting surface on a light-incident side of the reflecting surface.

100. (New) A variable optical-property element according to claim 99, wherein the reflecting surface is a rotationally asymmetric curved surface.

101. (New) A variable optical-property element according to claim 99, wherein the reflecting surface is formed as a Fresnel surface.

102. (New) An optical system comprising at least one variable optical-property element,

each of the at least one variable optical-property element comprising:

a reflecting surface formed as a curved surface; and

a layer made of a transmissive medium with a variable refractive index, the layer being provided on a light-incident side of the reflecting surface,

wherein the variable optical-property element is arranged to be decentered from an optical axis of the optical system.

103. (New) An optical system according to claim 102, further comprising a rotationally asymmetric optical surface,

wherein the rotationally asymmetric optical surface and the at least one variable optical-property element are arranged along a single traveling path of rays.

104. (New) An optical system according to claim 103,

wherein the optical system forms an image surface, and

wherein an image sensor is disposed on the image surface.

105. (New) An optical system according to claim 103, further comprising an optical element:

wherein the optical element has an entrance surface, a transmission surface, and an exit surface, and

wherein the at least one variable optical-property element and the optical element are constructed and arranged such that light enters the optical element through the entrance surface, exits from the optical element through the transmission surface, is reflected at the reflecting surface of the at least one variable optical-property element, re-enters the optical element through the transmission surface, and then exits from the optical element through the exit surface.

106. (New) An optical system according to claim 103, wherein the rotationally asymmetric optical surface defines only one plane of symmetry or no plane of symmetry.

107. (New) An optical system according to claim 103, further comprising an optical element:

wherein the optical element has a plurality of rotationally asymmetric optical surfaces.

108. (New) An optical system according to claim 102,

wherein the at least one variable optical-property element includes a first variable optical-property element and a second variable optical-property element,

wherein the optical system further comprises an optical element that has an entrance surface, an exit surface and at least two transmission surfaces, and

wherein the first variable optical-property element and the second variable optical-property element are arranged in a proximity of or in contact with the at least two transmission surfaces of the optical element so that light entering the optical element through the entrance surface is transmitted through one of the transmission surfaces, is reflected at the reflecting surface of the first variable optical-property element to re-enter the optical element, exits from the optical element through another of the transmission surfaces via reflection at an inside surface of the optical element or via no reflection, is reflected at the reflecting surface of the second variable optical-property element to re-enter the optical element through the another of the transmission surfaces, and then exits out of the optical element through the exit surface.

109. (New) An optical apparatus comprising an optical system that forms a two-dimensional image,

the optical system comprising a variable optical-property element,

wherein the variable optical-property element comprises:

a reflecting surface formed as a curved surface;

a layer made of a transmissive medium, the layer being provided on a light-incident side of the reflecting surface; and

a driver for changing a refractive index of the transmissive medium of the layer.

110. (New) An optical apparatus according to claim 109, wherein the variable optical-property element is arranged to be decentered from an optical axis of the optical system.

111. (New) An optical apparatus according to claim 109,

wherein the optical system further comprises an optical element, and

wherein the optical element has a rotationally asymmetric optical surface.

112. (New) An optical apparatus according to claim 111, wherein the rotationally asymmetric optical surface defines only one plane of symmetry or no plane of symmetry.

113. (New) An optical apparatus according to claim 111, wherein the optical element has a plurality of rotationally asymmetric optical surfaces.

114. (New) An optical apparatus comprising:

an optical element; and

a plurality of variable optical-property elements,

wherein each of the variable optical-property elements is decentered from a light-incident-side optical axis,

wherein the optical element has a rotationally asymmetric optical surface,

wherein each of the variable optical-property elements has an optical surface, a shape of the optical surface being changeable, and

wherein the variable optical-property elements and the optical element are arranged along a single traveling path of rays.

115. (New) An optical system comprising a plurality of variable optical-property units,

each of the variable optical-property units including an optical element having an entrance surface and an exit surface and a variable optical-property element constructed integrally with the optical element.

116. (New) An optical system comprising:

a reflection-type variable optical-property element having a variable optical power; and

an optical element having a rotationally asymmetric surface,

wherein the reflection-type variable optical-property element and the optical element are arranged along a single traveling path of rays and are arranged to be decentered from one another, and

wherein the rotationally asymmetric surface defines only one plane of symmetry or no plane of symmetry.

117. (New) An optical system comprising:

a plurality of variable optical-property elements each having a variable optical power; and

an optical element having a rotationally asymmetric optical surface,

wherein the plurality of variable optical-property elements and the optical element are arranged along a single traveling path of rays, and

wherein the variable optical-property elements and the optical element are decentered from one another.

118. (New) An optical system according to claim 117, wherein the optical element has a plurality of rotationally asymmetric optical surfaces.

119. (New) An optical unit comprising:

an optical element having a reflecting surface for performing inside-surface reflection; and

a variable optical-property element arranged integrally with the optical element.

120. (New) An optical unit according to claim 119, wherein the variable optical-property element has a variable optical power.

121. (New) An optical unit according to claim 120, wherein the reflecting surface is a rotationally asymmetric reflecting surface.

122. (New) An optical unit according to claim 120, wherein the reflecting surface and the variable optical-property element are arranged to be decentered from one another.

123. (New) An optical unit according to claim 120, wherein the optical element is a transparent body having an entrance surface in addition to the reflecting surface.

124. (New) An optical unit according to claim 123, wherein the optical element has a free-formed surface.

125. (New) An optical system comprising:

the optical unit according to claim 119; and

another optical element.

126. (New) An optical unit comprising:

a transparent optical element having an entrance surface and an exit surface that is different from the entrance surface; and

a reflection-type variable optical-property element having a variable optical power, the reflection-type variable optical-property element being arranged integrally with the transparent optical element,

wherein the transparent optical element and the reflection-type variable optical-property element are configured such that light enters the optical element through the entrance surface, is reflected at the reflection-type variable optical-property element, and then exits out of the transparent optical element through the exit surface.